AN ECOLOGICAL SURVEY OF THE PROPOSED UPPER GOOSE CREEK RESEARCH NATURAL AREA, SIX RIVERS NATIONAL FOREST, DEL NORTE COUNTY, CALIFORNIA

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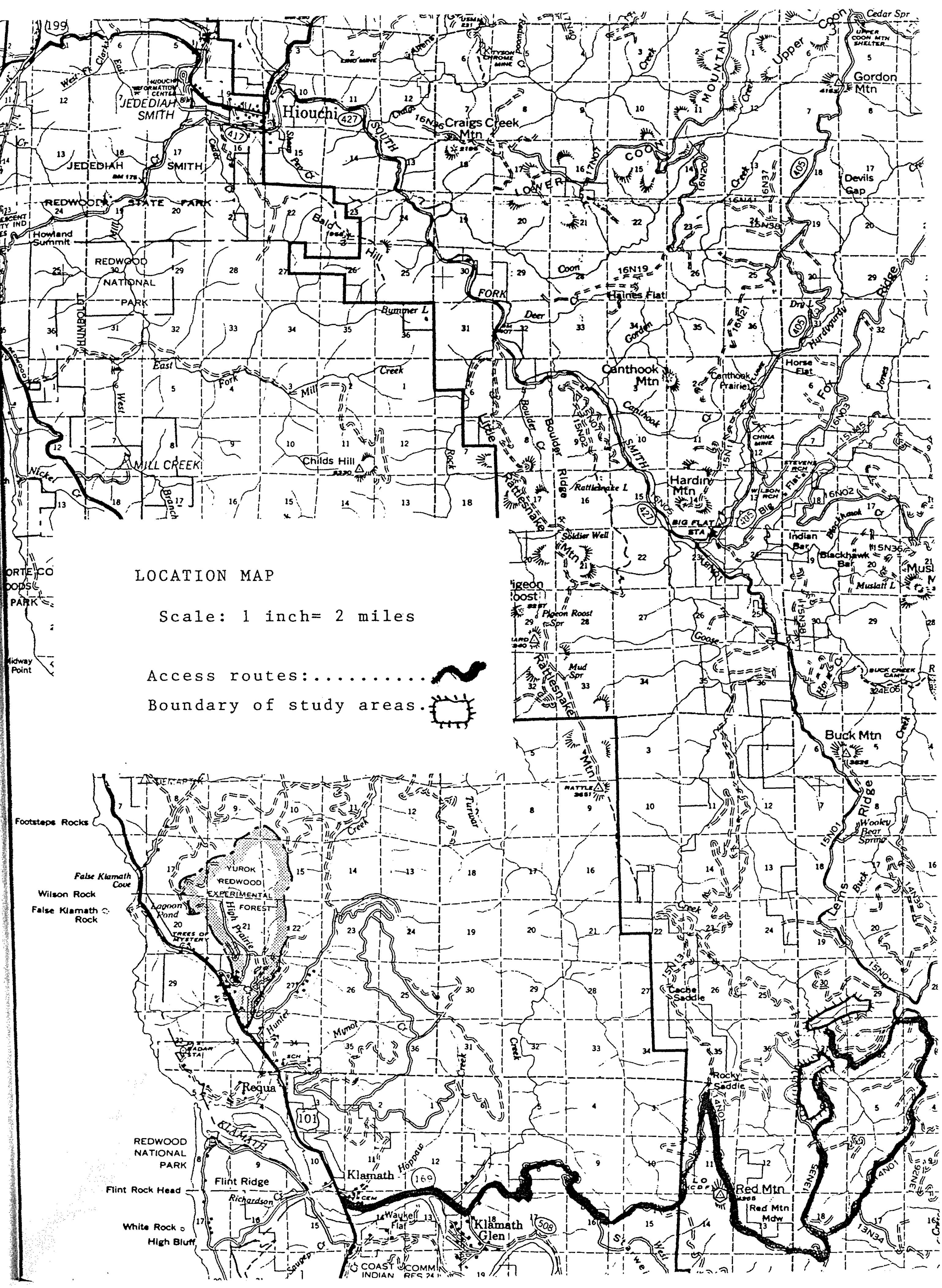
INTRODUCTION

The Upper Goose Creek Candidate Research Natural Area is composed of two distinct units both of which lie in small, unnamed tributary drainages of the East Fork of Goose Creek. These two units are separated by ca. 0.75 mile and occupy different sides of the East Fork of Goose Creek. In this report I will refer to them as the northeast and southwest units. Elevations range from ca. 1830-2450 ft. in the northeast unit and from ca. 1840-3440 ft. in the southwest unit. The southwest unit is the larger of the two covering ca. 320 acres, the northeast unit is ca. 140 acres. The northeastern unit lies in T. 14 N. R. 3 E. Sections 29, 30, and 31. The southwest unit lies in T. 13 N., R. 3 E., Section 6 and in Section 31 of T. 14 N., R. 3 E. The modal latitude and longitude is ca. 41° 33' N by 123° 52' W.

Accessibility:

Both units may be reached either from Highway 101 via Klamath Glen and the private logging road leading up toward Red Mountain, or by the G-O Road running south from Hiouchi (see Location Map). The former route is shorter for those approaching the sites from the south and involves traveling ca. eight miles of private logging road northeast of Klamath Glen until turning south at Rocky Saddle on the Forest Service road 14N01. The southwest unit is reached by taking road 13N35 north (ca. 5 road miles SE of Rocky Saddle) from 14N01 for ca. 2.5 miles at which point there is a three-way junction. The easternmost road of this junction leads down along the eastern perimeter of the southwest unit.

The northeast unit may be reached from the west by continuing along 14N01 for ca. 7 more miles until ca. 0.5 miles south of the G-O road


LOCATION MAP
Scale: 1 inch= 2 miles
Access routes:..........
Boundary of study areas.
Hiouchi
JEDEDIAH SMITH
JEDEDIAH SMITH REDWOODS STATE PARK
REDWOOD NATIONAL PARK
Howland Summit
Craigs Creek Mtn
Gordon Mtn
Devils Gap
Haines Flat
Canthook Mtn
Canthook Prairie
Horse Flat
Childs Hill
MILL CREEK
Hardin Mtn
BIG FLAT STA
Indian Bar
Blackhawk Bar
Muslatt L
Soldier Well
Pigeon Roost Spr
Mud Spr
Rattlesnake Mtn
Buck Mtn
Wooley Bear Spring
Cache Saddle
Rocky Saddle
Red Mtn
Red Mtn Mdw
Footsteps Rocks
False Klamath Cove
Wilson Rock
False Klamath Rock
Lagoon Pond
YUROK REDWOOD EXPERIMENTAL FOREST
High Prairie
TREES OF MYSTERY
Requa
KLAMATH
REDWOOD NATIONAL PARK
Flint Ridge
Flint Rock Head
White Rock
High Bluff
Klamath
Klamath Glen
Waukell Flat
COAST INDIAN COMM RES
199
427
417
405
101
169
508

(15N01). At this point a dirt road leads off to the southwest and subsequently branches into three roads. Take the southernmost (first) branch, which continues for ca. 2 miles down-slope along the upper margin of a large clear-cut and ends at a landing surrounded by burned slash. This point is ca. 0.25 miles south of the proposed boundary along the main East Fork of Goose Creek. Access from the north via the G-O road (15N01) is the same (in reverse order) once the road 14N01 is reached. Both 14N01 and 15N01 are paved two lane roads for most of their length and road 13N35 is a good dirt road. The logging spurs affording final access to both units were passable with a good clearance two-wheel drive vehicle in the summer of 1986, although both were showing signs of deterioration.

Because of the steep slopes, and thick vegetation in both adjacent clear-cuts and in more mature forest within the proposed RNA's, descent into the study sites and travel within them is somewhat difficult. Both sites have typically dense shrubby undergrowth which is difficult to penetrate. Progress along the streambeds in both areas is slow due to log jams, small cliffs, and waterfalls, but is generally easier than on the surrounding slopes.

Topography:

The northeast unit straddles ca. one mile of a small permanent stream trending west-southwest. The predominant slopes are northwest and southeast-facing. Slope angles are typically steep (40-50°) particularly in the inner gorge along the creek's lower reaches where intermittent small vertical cliffs 20-40 ft. high occur. The stream is joined by only one major tributary near the eastern boundary of the unit, which during the summer has a similar water volume to the main branch at the point of juncture

There are small alluvial benches at and just below the main tributary in the eastern portion of the unit and more extensive terrace deposits on both the north and south banks of the stream where it joins the East fork of Goose Creek. These latter deposits are between 10-35 feet above the streambed and may represent, at least in part, Pleistocene flood deposits.

The southwestern unit includes both the upper and lower slopes of a drainage containing a northeastward-trending small permanent stream. This stream has a slightly lower volume than the one in the northeastern unit, but its drainage pattern is more complex. It has two main forks which branch ca. half way up the drainage. The southern fork has the larger volume. However, the western fork is in a prominent ravine. Thus, slope exposures are more varied than in the northeast unit. They include; northwest, southeast, west, northeast, north, and east-facing aspects. Although the western edge of the drainage basin is on heavily-logged private land, a much larger percentage of the drainage is covered with unlogged forest than is the drainage containing the northeastern unit. Slope steepness is similar to that of the northeastern unit and a steep inner gorge is prominent along the lower third of the drainage. Small alluvial benches exist near the junction of the two forks and a small alluvial terrace ca. 25-35 ft. above stream level occurs on the south side of the stream near the junction of the East Fork of Goose Creek.

History of Scientific Interest:

The proposed Upper Goose Creek RNA has only a brief history of scientific interest. The area was suggested as an RNA in a proposal dated December 19, 1984 signed by the Six Rivers Forest Supervisor. According to this proposal it was selected as a representative of the Douglas-fir-

Western Hemlock type (SAF type 230). This type is poorly represented on Forest Service Land in California. According to the proposal, most of the SAF type 230 in the Klamath Province is on private land and has been logged.

Because no formal reconnaissance report was conducted by a member of the R 5 RNA committee or a local Six Rivers designate, the Type 230 thought to be present in the two units is actually poorly represented. Although Douglas-fir and western hemlock do occur in mixed forests on both units they don't occur in communities typically referable to type 230. Instead, due to a significant and previously unmentioned Port Orford Cedar component in both units the target element is actually more closely allied with SAF type 231 (Port Orford Cedar-Douglas-fir). The element containing a mixture of *Pseudotsuga, Chamaecyparis*, and *Tsuga heterophylla* is confined to the bottoms of the two drainages, only rarely ascending north-facing slopes more than 50 m from the streambed. Surrounding slopes are a mixture of associations related to the Pacific Douglas-fir (SAF type 229) and Oak-Madrone (type 234) types.

Regardless of the absence of the originally designated target type 320, SAF type 231 is also an important element because of its scarcity on Forest Service Lands in California and because of the need to protect viable old growth stands of Port Orford Cedar from root rot fungus.

JUSTIFICATIONS FOR ESTABLISHMENT

Port Orford Cedar-Douglas-fir-Western Hemlock Forest:

The forest lining the canyon bottoms of these two drainages is a high volume, old growth association dominated by Port Orford cedar (POC) and Douglas-fir, with local western hemlock dominance. According to Atzet and Wheeler's (1984) classification system this forest is a POC-Salal type

They consider this association to be the most variable of the several POC associations they define. Franklin and Dyrness (1973) consider this type of forest as the POC **variant** of the *Tsuga heterophylla* zone, restricted to the southern Oregon Coast Ranges and to adjacent Northwestern California. Locally, this forest is dominated by frequently very large and tall individuals of the three principal species. Several POC were measured between 5 and 6 ft. dbh and between 200 and 225 ft. tall (Figure 1). More of these giants occur in the southwest unit, but some do occur in the northeast unit as well. These trees rival the largest POC recorded, and if established, this RNA would certainly contain the largest and perhaps the oldest of any protected stands of this species in California. It was impossible for me to age the largest individuals in the area, however several smaller trees were aged at between 410 and 600 years suggesting that the largest are well over 800 years . In addition to the exceptionally large POC, the Douglas-fir in the lower canyon bottoms also attain great size. Several 5-6.5 ft. dbh *Pseudotsuga* were seen in both units. These trees were not so impressive for their girth as for their height. Several were clearly over 200 ft. tall and three were measured between 240 and 250 ft. Western hemlocks were smaller than the previous species, but still of respectable size. Several at each unit were between 2.5 and 3.5 ft. dbh and the tallest measured was ca. 175 ft.

The tendency for POC and hemlock to dominate over *Pseudotsuga* in the creek bottoms indicates the climax nature of this association *Pseudotsuga* is not reproducing in the understory of this forest and few small to medium sized trees of this species occur. On the other hand both POC and hemlock are reproducing well with several age classes represented

Forest Service land which is undisturbed, off of ultramafic soil, and coastal enough to support western hemlock is rare in California. The original prime habitat for this species is generally west of the Six Rivers Forest boundary and has been extensively logged. The extent of POC off of ultramafic (serpentinite, peridotite, gabbro, etc.) substrates is also limited in California. In California the habitat overlap of these two species is quite limited (see Griffin and Critchfield 1972) because western hemlock is generally intolerant of ultramafic soils while POC typically has competitive problems off of ultramafic soils. However small and atypical their cooccurrence is at present, it is very significant from an ecological and paleobotanical perspective. The widespread fossil occurrence of POC throughout the western United States off of ultramafics (Raven and Axelrod 1978) suggests that during more moist times it commonly associated with western hemlock and other Arcto-Tertiary elements. Thus the forest at the bottoms of these canyons is similar to those which were widespread earlier in the Tertiary. The dominant POC and western hemlock are important from an ecological perspective because they represent the true climatic climax of this environment. Douglas-fir is extremely widespread and the principal dominant species over much of the non-ultramafic terrain at lower elevations in the Klamath Province, however it is frequently a subclimax or fire-climax tree. Its presence on the upper slopes of these two drainages is indicative of this type of seral state. However, the presence of only large trees in the canyon bottoms without reproduction supports the theory that without canopy-damaging fire POC and western hemlock will maintain dominance. Climax forests of both of these species are extremely rare in California and are deserving of study

Comparison with the Proposed Adorni RNA:

Another candidate RNA in the Klamath Province has been selected as a representative of SAF type 231. The Adorni CRNA occurs on the Orleans RD and lies ca. 25 miles SSE of the Goose Creek units. This area was studied by Sawyer (1980). In summary, the area differs from the present units by having no western hemlock, relatively small trees of POC, and dominance by Douglas-fir throughout all areas with significant POC presence. Reproduction is present for all dominant trees . It also has been salvage-logged throughout its western portion and occurs in a drier, more interior climate (although on the same geologic substrate) as Upper Goose Creek. The only association that is more poorly represented at Goose Creek than at Adorni is the upland type with POC intermixed with Douglas-fir in the canopy.

From the standpoint of the principal values of climax vegetation, tree size, and age of the climax community, Goose Creek is superior to Adorni. However Adorni is representative of a more interior and southerly type of POC association and thus can't be directly compared with Goose Creek.

Pseudotsuga-Hardwood Forests:

The largest percentage of land on both units is covered by a combination of *Pseudotsuga*-hardwood forests. These forests are variable with regard to fire history and slope exposure and have typically been called either Douglas-fir forest or mixed evergreen forest (e.g Munz 1959). The more mature hardwood understory in the northeast unit with concurrent relatively minor singeing and fire-scarring of the trunks of the dominant Pseudotsugas suggests that fire has not been as frequent in this drainage as in the southwestern unit where large fire scars and a relatively small-

stature hardwood component are typical (see figures). Comparisons between these forests on each unit hold promise for increasing the knowledge of successional trends in this very important timber type. The location of this *Pseudotsuga*-dominated forest in an area of very high rainfall and on relatively benign soils makes it highly productive. Non-human-altered forests of this highly productive type are uncommon in California and baseline studies on natural regeneration and growth rates would prove useful to the proper management of such forests.

GEOLOGY

The rocks underlying both units of the proposed RNA belong to the Galice Formation. This is predominately a late Jurassic **meta** sedimentary layer which is thousands of feet thick (Irwin 1966, 1981). At the study sites the rock is commonly schistose with interbeddings of graywacke sandstone. It along with the Josephine Peridotite forms the western boundary of the Klamath Geologic Province. Rocks are usually exposed as small fragments on the surface with larger outcrops only in the lower stream bottoms or occasionally on ridge lines. The weathered rock is relatively soft and crumbly. Typical exposures are tan to light brown with noticeable micaceous sheen. According to Scott et al (1980) the formation is texturally and structurally weak. Erosion on logged lands adjacent to the study sites and along the main stream of the East Fork of Goose Creek tend to support this.

SOILS

Rocky et al (1966) have mapped portions of the Galice terrane on the Orleans District. Similar soils at Goose Creek may be considered members of the Sheetiron and Hugo soil complexes. Most of the area is probably underlain by steep (40-70%) Sheetiron soils, which have been described by Rocky et al as prone to large scale landslides. Although small hummocky areas (pointing to ancient landslides) were seen locally within the forests, the only major old slide noticed was near the steep head of the southwestern unit drainage. This slide had moved probably over 100 years ago and is now stabilized by relatively large trees. The Sheetiron soils are generally very well-drained with a grayish brown surface layer with a gravelly loam texture. The subsoil color ranges from pale brown to yellowish brown, and brownish gray with a gravelly loam texture. Acidity is probably medium in the surface layer and strong in the subsoil. Soil depth is ca. 16-32 inches.

Hugo soils may occur in the shallower and less steep soils of the area. These have been classified as Typic Dystrochrepts by Laake (1979). Undoubtedly the soils underlying the small alluvial terraces along the main Goose Creek and the two small tributaries are the deepest and most fertile in the area.

CLIMATE

The climate of the study area is quite wet by California standards. Although no recording stations occur within the vicinity of the sites, Kahrl (1979) estimates that rainfall for the upper Goose Creek basin averages in the neighborhood of 100 inches per year. Because the area is to the east of the relatively high Red Mountain it probably receives little summer fog and

slightly lower precipitation than on the crest of Red Mountain. During my visit in late July fog was absent from the entire area. Temperatures at this time ranged from 78° F during midday to 45° F in pre-dawn morning. Winter temperatures are probably relatively mild. Snowfall is fairly common above 2500 ft., but does not usually linger on the ground for more than a day.

VEGETATION

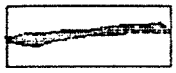
A generalized map of the vegetation of the two units with approximate aerial coverage of the types is presented on the following page. Descriptions of the principal vegetation types have been based on both quantitative and qualitative assessment. Quantification was limited to the target type of SAF 231 where 10 plots were sampled in the southwest unit and eight in the northeastern unit. An additional two plots were sampled in the *Pseudotsuga*-hardwood forest in the northeastern unit. These plots were all 10 x 10 m in size and were subjectively chosen to represent typical situations. The following vegetation types were recognized from this study: POC-Douglas-fir-western hemlock valley bottom forest (equivalent to SAF type 231); north-facing Douglas-fir-hardwood forest; south-facing Douglas-fir-hardwood forest; riparian woodland; and recently damaged successional woodland.

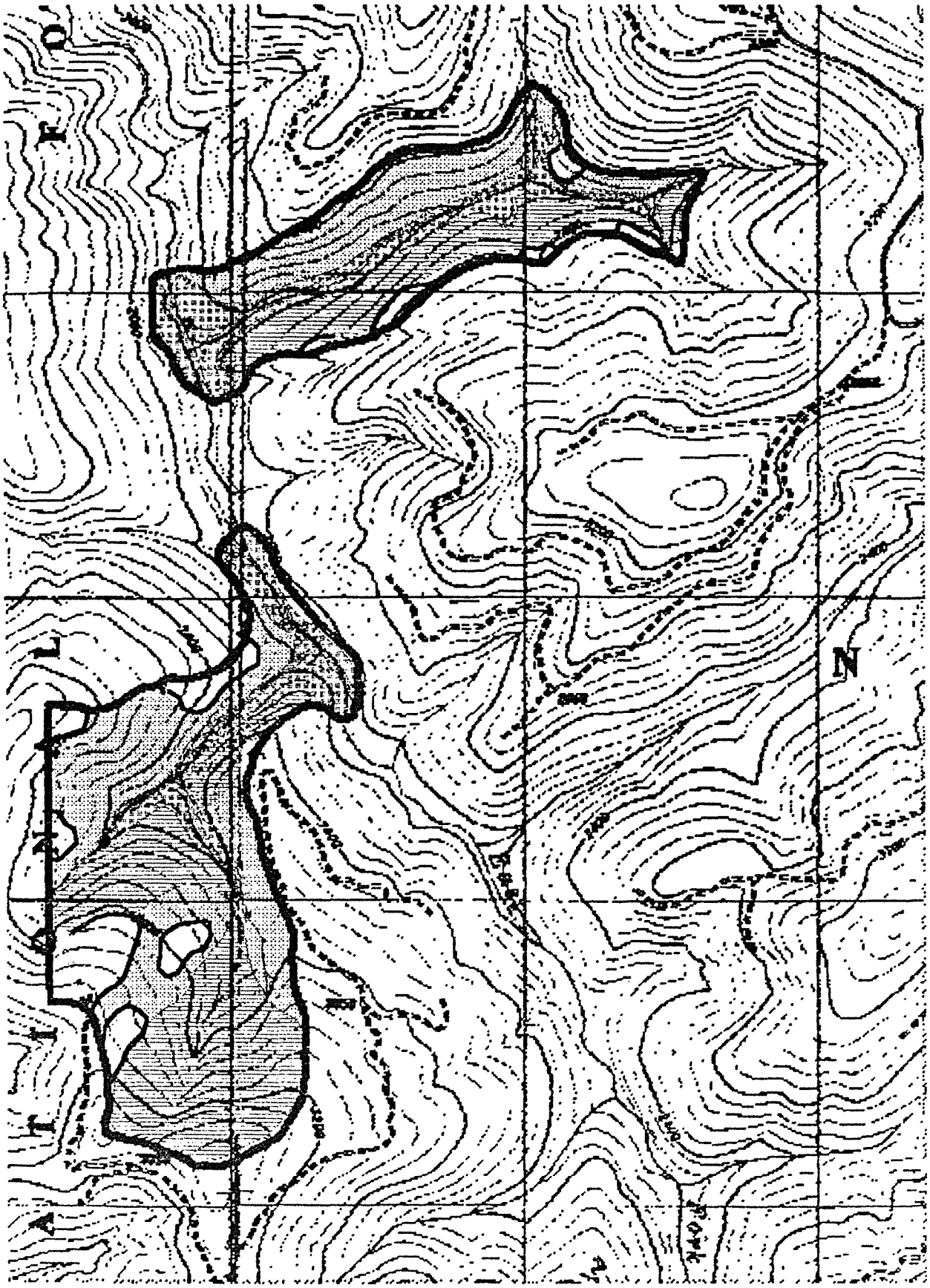
Port Orford Cedar-Douglas-fir-Western Hemlock Forest(Chamaecyparis - Vaccinium-Polystichum Association):

This forest type includes all of the very mesic forest where the two climax species occur. It can be divided into two main types; that which contains a significant western hemlock element and that which is

LEGEND FOR VEGETATION MAP

SCALE: 2 INCHES = 1 KM

SYMBOL	AREA (HA) SW unit	AREA (HA) NE unit	TYPE
	5	7	riparian
	12.5	13	POC-Douglas-fir-W hemlock
	57	18	N-slope Douglas-fir
	33	27	S-slope Douglas-fir
	17.5	5	successional forest
Totals:	125	70	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codominated by POC and Douglas-fir, without hemlock. The POC-Douglas-fir type is the most widely distributed of the two. While POC occurs along the entire canyon bottom within the northeast unit and along most of the permanent portions of the creek in the southwest unit, hemlock is more restricted to the lower portions of both of these drainages. Hemlock dominance is restricted to very mesic alluvial terraces and relatively gently-sloping deep soils, while POC may dominate along steep banks with shallow soils, as well as on deeper, more level soils.

Eighteen 100 m^2 plots were sampled in this association. Ten in the southwest unit and the remainder in the northeast unit. Table 1 summarizes the results of the samples for trees over 2 m tall. Based on importance values (relative density + relative frequency + relative cover X 100) POC is the most important tree with a value of 105 followed in order by Douglas-fir, western hemlock, vine maple, tanoak, big-leaf maple, pacific dogwood, and giant chinquapin. Other trees not detected in the samples include *Lithocarpus densiflora* which is abundant in adjacent drier forests, *Alnus oregona*, which enters the forest from the adjacent riparian woodland, and the occasional *Taxus brevifolia*. The dominant tree based on basal area is Douglas-fir with 65% more basal area than the second dominant, POC. However, as can be seen in Table 2, Douglas-fir is the least important of the six species of trees represented by saplings and seedlings. Tanoak is a relatively important reproducer. However, most of these saplings remain shade-suppressed and eventually die before reaching large size. The high hemlock reproduction recorded in the samples is basically due to an extremely high number of yearling seedlings which carpeted the ground on two plots. As indicated by their density and the paucity of older hemlock seedlings and saplings, the vast majority of these yearlings will die within

Table 1: Summary of vegetation data collected for trees over 2 m tall on 18 100m^2 plots in Port Orford cedar-Douglas-fir-western hemlock forest at Upper Goose Creek.

species[a]	den.[b]	freq.	cover (in.^{2})	rel.den.	rel.freq.	rel.cov.	imp. val.
POC	0.063	0.94	18664.06	0.438	0.285	0.329	105.2
DF	0.017	0.88	28481.27	0.118	0.267	0.502	88.7
WH	0.40	0.65	8718.81	0.278	0.197	0.154	62.9
VM	0.017	0.29	74.58	0.118	0.088	0.001	20.7
TO	0.003	0.24	62.83	0.020	0.073	0.001	9.4
BLM	0.001	0.12	656.01	0.007	0.036	0.012	5.5
PD	0.002	0.12	53.4	0.014	0.036	0.001	5.1
GC	0.001	0.06	17.65	0.007	0.018	nil	2.5
Totals:	0.144	3.30	56728.61	0.999	1.000	1.000	300.0

[a]POC= *Chamaecyparis lawsoniana*; DF= *Pseudotsuga menziesii*; WH= *Tsuga heterophylla*; VM= *Acer circinatum*; TO= *Lithocarpus densiflora*; BLM= *Acer macrophyllum*; PD= *Cornus nuttallii*; GC= *Chrysolepis chrysophylla*.

[b]column symbols: den =density (stems per m^2); freq =frequency; cov.=cover of stem at dbh; rel.den=relative density; rel.freq.=relative frequency; rel.cov =relative cover; imp.val.=importance value.

Table 2. Summary of vegetation data for saplings and seedlings on 18 10 x 10 m plots in POC-Douglas-fir-western hemlock forest at Upper Goose Creek.

species	den.	freq.	rel.den.	rel.freq.	I.V.
WH	0.292	0.444	0.827	0.253	108.0
TO	0.021	0.588	0.059	0.335	39.4
POC	0.032	0.444	0.091	0.253	34.4
VM	0.004	0.111	0.011	0.063	7.4
GC	0.001	0.111	0.011	0.063	7.4
DF	0.003	0.056	0.009	0.032	4.1
Totals:	0.353	1.754	1.008	0.999	200.7

Table 3: Frequency and mean % cover of shrubs on 18 10 x 10 m plots in POC-Douglas-fir-western Hemlock forest at Upper Goose Creek.

species	frequency	x % cover
Gaultheria shallon	0.67	11.3
Rhododendron macrophyllum	0.61	10.0
Vaccinium ovatum	0.83	8.8
Vaccinium parvifolium	0.72	7.2
Berberis nervosa	0.44	3.3
Corylus cornuta	0.17	0.2
Rubus ursinus	0.17	0.1
Rubus leucodermis	0.06	0.0

a few years. Although hemlock seeds and germinates more prolifically than POC, the latter species is represented by more large seedlings and saplings in the samples. POC has a wider representation of age-classes, indicating that seedlings regularly survive and reach sapling and tree size in the forest understory. This finding is in conflict with Franklin and Dyrness (1973) who report that in southwestern Oregon, POC appears (as does *Pseudotsuga*) to be a long-persisting seral species which does not reproduce well in mature forest. They suggest that POC is quite fire-resistant and cite its thick bark and numerous conspicuous cat-face scars on mature specimens as proof. While older trees may be fire resistant (Figure 2), it is not clear if the trees respond to fires by seeding prolifically as a true fire-adapted species would. Zobel and Hawk (1980) discovered that in the *Tsuga heterophylla* zone POC seedlings did grow in deep shade under similar light conditions to *Tsuga heterophylla* seedlings. Figures 3 and 4 show both POC and hemlock seedlings growing in similar conditions on decaying mossy logs. Both species also germinate and grow on shaded non-mossy soil with relatively high duff accumulation.

The shrub understory of this forest is dominated by ericaceous species (Table 3). The average cover of shrubs on the 18 plots was ca. 40%. *Gaultheria, Rhododendron, Berberis*, and the two species of *Vaccinium* are widespread in this type as well as in adjacent *Pseudotsuga*-dominated forest. No shrub species are restricted locally to this type. Because of the relatively deep shade shrubs are not as important as in adjacent more open *Pseudotsuga* forest where their cover may approach 90%. One of the major differences between the hemlock subtype and the POC-Douglas-fir subtype is that the former type has a much lower cover of shrubs associated with its very shady understory (Figure 5)

Herbs in general are not an important understory component in this forest (Table 4). Although 25 species were recorded on the sample plots only three species, *Polystichum munitum, Blechnum spicant*, and *Coptis lacinata* accounted for anything more than trace cover (Figure 6). *Polystichum* was the only species which occurred on most of the plots and accounted for an average cover of almost 12%. The dense shade provided by the physical environment of the deep, narrow valley bottoms, and the tall dense forest excludes all but the most shade-tolerant species. Although not included on the plots, *Oxalis oregana* is a locally important species along with *Polystichum* on the alluvial deposits with high hemlock importance along the East fork of Goose Creek (Figure 7).

According to Franklin and Dyrness (1973) an understory dominated by *Polystichum* and *Oxalis* is indicative of the most moist sites in the *Tsuga heterophylla* zone, while the sites dominated by *Gaultheria shallon* represent the dry end of the moisture spectrum. Intermediate sites are characterized by understory dominance by *Rhododendron macrophyllum* and *Berberis nervosa*. This scheme works fairly well at the Goose Creek sites. The abundance of *Polystichum* and *Gaultheria* on the sample plots points to the intermediate nature of the local forest regarding moisture availability. According to Franklin and Dyrness, in some areas an understory codominated by these two species is also typical of modal conditions in the western hemlock zone. Additional data in Franklin and Dyrness suggest that most of the sampled area is on the high end of the moisture scale for the western hemlock zone. The following species are among the most important herbaceous understory components of the local Goose Creek forests and are also listed as members of the more moist types of *Tsuga heterophylla* forest in Franklin and Dyrness: *Aconitum triphyllum, Trillium ovatum,*

Table 4. Frequency and mean % cover of herbs on 18 10 x 10 m plots in POC-Douglas-fir-western hemlock forest at Upper Goose Creek.

Species	frequency	x % cover
Polystichum munitum	0.67	11.8
Blechnum spicant	0.22	2.1
Coptis lacinata	0.27	0.7
Achlys triphylla	0.28	tr.
Disporum hookeri	0.22	tr.
Trillium ovatum	0.33	tr.
Goodyera oblongifolia	0.28	tr.
Tiarella unifoliata	0.22	tr.
Smilacina racemosa	0.17	tr.
Adenocaulon bicolor	0.11	tr.
Viola sempervirens	0.11	tr.
Trientalis latifolia	0.11	tr.
Linnaea borealis	0.06	tr.
Vancouveria hexandra	0.06	tr.
Pyrola asarifolia	0.06	tr.
Montia cordifolia	0.06	tr.
Anemone deltoidea	0.06	tr.
Whipplea modesta	0.06	tr.
Galium triflorum	0.06	tr.
Adiantum pedatum	0.06	tr.
Xerophyllum tenax	0.06	tr.
Chimaphila *menziesii*	0.06	tr.
Corallorhiza sp.	0.06	tr.
Pteridium aquilinum	0.06	tr.
Clintonia uniflora	0.06	tr.

Polystichum munitum, Coptis lacinata, Tiarella unifoliata, Disporum hookeri, and *Blechnum spicant.*

At Goose Creek the sites with *Tsuga heterophylla* as an important species are typically moister, with deeper soils than the POC-Douglas-fir sites. This is not only indicated by changes in the understory composition from *Polystichum* dominance to *Gaultheria, Vaccinium,* and *Rhododendron* dominance, but also by the clear physical positioning of the two species. In a few areas on north-facing slopes both species ascend the slopes for over 150 meters . However, in most of these cases POC drops out higher up-slope than hemlock.

Growth rates in this forest are relatively slow until the canopy is reached. Light limitation is primarily responsible for this, as typical *Pseudotsuga* site index listings for these types of forests are generally very high (between ca. 115 and 165 ft./100 years according to Franklin and Dyrness). Three sampled western hemlock between 22 and 28" dbh were 160-222 years old. One hemlock ca. 170 ft. tall and 35" dbh was ca. 300 years old. A 16" dbh POC was aged at 95 years. Old POC tended to have fire scars and damaged heartwood, but two were successfully aged. One was 30" dbh, had an age of 426 years at that point, and was ca 150 ft. tall. Another POC with a dbh of 34.5" was partially cored (core length of 8.5") and gave an age of 395 years. With an additional 5 inches to the heart likely, I extrapolated this specimen to be ca 604 years old. Thus, the largest specimens at nearly six ft. dbh may be exceptionally old (perhaps 1000 years or more).

Pseudotsuga-dominated Forests:

A vast area of the Western Klamath Province is covered with forest dominated by Douglas-fir (Sawyer et al 1977). Two main approaches to vegetation classification of this realm have been suggested based on either environmental influences such as slope exposure and substrate (e.g. Whittaker 1960) or fire history (Sawyer et al 1977). Both are undoubtedly important influences (Keeler-Wolf 1987). Although the drier portions of the province may most clearly show the effects of patterning based on environment, the relatively wet, coastal portions of this vegetation zone such as at Goose Creek, probably show the effect of fire history and other disturbance to a greater extent. It appears that a tall relatively dense *Pseudotsuga* canopy will develop on virtually all slope exposures and steepnesses within the study area barring any major canopy damage for perhaps 150 years (Figure 8). However, the widespread and periodic effect of fire and recently, of logging has complicated this pattern. Many south-facing exposures in the vicinity of the study area are now dominated by hardwoods such as *Lithocarpus densiflora, Arbutus menziesii*, and *Quercus chrysolepis* (Figures 9 and 10). However, these trees are generally small and relatively young (>100 years in most cases). Southerly facing exposures are more prone to canopy fires than northerly exposures simply because their understories are drier in the summer months when most damaging fires occur. However, the dominance of hardwoods on some northerly exposures (see Figure 10) does suggest that if a canopy fire occurs on a north slope a similar seral hardwood vegetation will develop.

In this discussion I will describe the vegetation based on its present representation of dominant species, but will relate this to its seral stage in each case. I only sampled two plots in this large and diverse zone , both

on north-facing exposures. Thus, a large part of this discussion is based on qualitative observation.

North-facing slopes (Pseudotsuga-Chrysolepis-Rhododendron Association):

On most of the north-facing slopes in the two study drainages *Pseudotsuga* forms a distinct canopy with a relatively mesic understory which grades gradually up from the moist understory of the POC-Douglas-fir forest in the canyon bottoms. In most cases the *Pseudotsuga* canopy is even-aged with the dominant trees forming a cohort which can be traced back to the period following the last major crown fire in the area (Figure 11). As was mentioned, fire frequencies are different between the two drainages with the southwest unit showing clear evidence of more recent and probably more frequent fire damage. However, on most north-facing slopes both units have similar sized and aged *Pseudotsuga* canopies. Typical sizes and ages of canopy trees in both units range between 30 and 45" dbh and 200-250 years old. Canopy height is ca. 160-180 ft., substantially lower than the canopy of the POC-Douglas-fir forest in the valley bottoms. Density of the canopy trees is relatively low (some have been selectively logged in the SW unit) and averages ca. 120-200/ha. Saplings and seedlings are rare as are young trees. The smallest trees may be only 12-14 inches dbh but appeared to be suppressed and most were at least 175 years old. Competition for sunlight with the dense understory layers and the presence of relatively heavy duff is primarily responsible for the lack of recent reproduction.

The understory of these relatively moist *Pseudotsuga*-dominated forests is typically composed of two distinct layers of sclerophylls; a sub-canopy of hardwoods dominated by *Chrysolepis chrysophylla* with

occasional *Lithocarpus densiflora*, *Arbutus menziesii*, and *Quercus chrysolepis* overlying a dense shrub layer dominated by *Rhododendron macrophyllum, Vaccinium ovatum,* and *Gaultheria shallon.* Herbs are relatively unimportant except for tufts of *Xerophyllum tenax* and occasional sprigs of *Pteridium aquilinum* and *Disporum hookeri*. In the more recently fire-damaged southwest unit the hardwood sub-canopy is relatively low, composed of mostly shrubby resprouts of *Lithocarpus* and chinquapin with heights of only ca. 20-35 ft. and dbhs of between 3-8 " (see Figure 11). Only occasional larger hardwoods remain which may be 20-24" dbh and 90 ft. tall. Larger trees are much more common in the forests on the northeast unit (Figure 12). Typical sizes of the dominant sub-canopy hardwood, *Chrysolepis*, on two plots in north-facing forest on the NE unit ranged between 11 and 16 inches. but a number were seen which ranged between 20-25" dbh and 22-28 m tall.

Beneath the sub-canopy *Rhododendron* and *Vaccinium ovatum* are usually dominant with typical cover of 40-50% for each species. *Rhododendron* is usually a taller shrub from 5-15 ft. tall while *V. ovatum* is usually under 6 ft. *Gaultheria* may typically cover 15-15 % of the ground. This type of understory is typical from ca. 2000 ft. to over 3200 ft. elevation on these northerly exposures. However, at the higher elevations *V. ovatum* tends to drop out with dense cover provided mostly by *Rhododendron* (Figure 13).

West-to-Southerly slopes (Pseudotsuga-Lithocarpus-Gaultheria association):

The canopy remains dominated by *Pseudotsuga* on more xeric exposures in these drainages where fire has not destroyed it in the past 150 years. However, the sub-canopy and understory are substantially different

from the more mesic north slopes just discussed. Occasional *Pinus lambertiana* occur on the upper slopes usually with west exposures. Douglas-fir appears to grow slightly more rapidly on these sunny exposures than on more sheltered sites, with trees reaching dbhs of 4-5 ft. in ca. 300 years. One individual on a west-facing slope grew to a dbh of 32" in 145 years with the first 50 years of growth averaging ca. 0.35 " per annual increment. Reproduction is virtually absent in areas with intact canopies. Tree heights are generally similar to those of north-facing slopes, although tree densities may be somewhat lower. This allows the subdominant hardwoods to increase in importance in the open understory relative to north-facing slopes. However, the density of *Pseudotsuga* appears greater on these exposures in this relatively wet area than in drier, more inland forests with similar exposures (Keeler-Wolf 1987). Thus, the overall impression for these drainages is of *Pseudotsuga*-dominated forest on all mid and upper slope exposures which have not recently suffered crown fires.

The understory is again dominated by sclerophylls. However, *Chrysolepis* is usually substantially less important than on northerly exposures and the sub-canopy is usually clearly dominated by *Lithocarpus*. *Arbutus menziesii* and *Quercus chrysolepis* are both substantially more important than on the more sheltered exposures. *Acer macrophyllum* is occasional in concavities. In general, the largest understory trees are *Arbutus*, some of which reach 35" dbh and 100 ft. tall. Some of these large trees occur even in the more recently damaged understory of the southwest unit (Figure 14) and are clearly survivors of the most recent fires in the area.

Beneath the sub-canopy the understory has a decidedly more xeric aspect than those on north-facing slopes. *Rhododendron* is uncommon

except in the lowest portions of drainages, while *Berberis nervosa* and *Gaultheria shallon* are relatively more common than on north slopes. West-facing slopes mid-way up slope typically have a dense cover of *Gaultheria* (up to 90%) while more due south or upper ridge exposures tend to have a less dense mixture of *Berberis* and *Gaultheria* with *Pteridium, Rubus ursinus*, *Arctostaphylos cinerea*, and *Toxicodendron diversiloba*. Herbs are relatively scarce and include *Iris* sp., *Xerophyllum tenax*, and *Campanula prenanthoides*

Successional Forest:

Large portions of the vegetation on the mid and upper slopes of both the study drainages have been disturbed either with crown fire, clearcutting or a combination of both over the past 60 years or so. The resulting seral vegetation appears substantially different from either north-facing or south-facing *Pseudotsuga*- dominated forest, although clearly derived from them. A large number of clear cuts have been made on Forest Service land adjacent to the study areas since the early 1970's. Typically these cuts have been replanted with *Pseudotsuga* and some cuts have already been thinned and presently have trees 15-20 ft tall. The typical natural vegetation to occur on these 10-15 year old cuts is dominated by the large shrub *Ceanothus velutinus* var. *laevicaulis*. This shrub with slightly viscid aromatic foliage forms dense thickets up to 15 ft. tall on all slope exposures. Beneath these shrubs occur lesser numbers of shrubby resprouts and seedlings of *Lithocarpus, Arbutus, Chrysolepis* and *Quercus chrysolepis* as well as scraggly shrubs of *Rosa gymnocarpa, Rubus leucodermis* and *Toxicodendron diversiloba*. Skid trails and more heavily disturbed areas tend to be dominated by thickets of Douglas-fir saplings with occasional

herbaceous openings with the following species: *Agrostis exarata, Deschampsia elongata, Whipplea modesta,* and *Erechtites arguta*.

On the western portion of the southwest unit, where it abuts the private land there appears to have been a combination of logging activity and fire in the past several decades. This has produced a relatively thick growth of sclerophyllous hardwoods interspersed with young *Pseudotsuga* and occasional large fire-scarred survivors. The largest portion of this recently disturbed area has a southeast-facing exposure and is dominated by *Lithocarpus* with *Arbutus* and *Q. chrysolepis* and small trees of *Pseudotsuga* as subdominants (see Figure 9). A smaller portion occurs on east and northeast-facing exposures and appears to have a higher representation of *Chrysolepis* with *Lithocarpus, Arbutus*, and *Pseudotsuga* as subdominants (Figure 15). These sclerophyllous trees are typically 25-40 ft tall with dbhs of ca. 12-14". Two relatively distinct patches of *Pinus attenuata* also occur on these southeast slopes. Knobcone pine typically germinates only after fire, and the age of most of these pines is similar to the age of the dominant hardwoods, ca. 45-55 years. Thus, a fire probably destroyed all or a portion of the canopy in this area ca. 50 years ago. This fire probably was the most recent to sweep through the southwest unit and is probably the same one which destroyed the hardwood understory in most of the *Pseudotsuga*-dominated forests. Certain portions of the southeast-facing slopes are dominated by ca. 100 ft. tall *Pseudotsuga* These areas are adjacent to large undisturbed stands of older *Pseudotsuga* which much have acted as a seed source for the younger dense forest. It appears that this forest must have burned prior to the previously mentioned fire.

On aerial photos a distinct vegetation transition separates the private land and Forest Service Land. Numerous logging roads in various stages of revegetation suggest the private land was clear-cut at various times over the past 40-50 years. The timing of the cutting adjacent to the southwest unit and the timing of the fire looks to be concordant. Perhaps the cutting of the forest was initiated after a large fire had scorched and killed, but not engulfed the canopy.

Riparian Woodland:

Both units have riparian vegetation lining the streams. These woodlands are restricted to perennial moisture and form a relatively narrow ecotone with the adjacent POC-Douglas-fir-hemlock forests. The riparian zone along these narrow, shaded creeks is characterized by relatively shade-tolerant hydrophilic species. The dominant woody species is *Alnus oregona* (*A. rubra*), which attains substantial size. Several trees over 24" dbh (largest measured 32") and ca. 100 ft. in height were seen along both drainages. These trees do not form a continuous canopy and typically occur intermittently along the streams interspersed by a more uniform cover of shrubs and herbs. These include: *Ribes bracteosum, Euonymus occidentalis, Rubus spectabilis, Rhamnus purshiana, Boykinia elata, Mitella ovalis, Aralia californica, Athyrium filix-femina, Adiantum pedatum, Tellima grandiflora, Carex ormantha, Agrostis longiligula, Calamagrostis foliosus, Woodwardia fimbriata, Petasites palmatus,* and *Aquilegia formosa* (Figure 16).

Along the main branch of the East Fork of Goose Creek the alluvial bed is wider, stream level fluctuates much more than in the small tributaries, and there is more intense insolation (Figure 17). These factors combine to create a slightly different riparian zone. *Alnus* on Goose Creek is typically

not as tall a tree and is more shrubby, probably as a result of regular flood damage. A number of the more shade-toler nt species such as *Tiarella, Tolmia,* and *Boykinia* are generally absent. One species that is particularly associated with the main stream riparian is *Phacelia bolanderi*.

IMPACTS

The principal real and potential impacts on the proposed RNA include 1) logging and associated erosional problems from roads and removal of forest cover adjacent to the study areas, and 2) protection of the POC stands from *Phytophthora lateralis*, the root rot fungus. Both of these principal impacts are, of course, associated. Without the opening up of the area for logging, the root rot fungus would not be in danger of spreading. From the point of view of integrity both units suffer because they have dirt roads and logged portions within their drainages. This is a concern for several reasons : 1) fungus could enter the drainage on truck and car fenders and spread down to the POC stands; 2) erosion resulting from logging practices could damage portions of the study areas either directly from uphill roads and cuts or indirectly from increased sediment loads during runoff periods tending to erode the banks of the main East Fork within the proposed boundaries; and 3) the presence of unnatural areas within RNA's is generally unacceptable.

RECOMMENDATIONS FOR PROTECTION AND MANAGEMENT

Despite the above difficulties, I do believe that the Upper Goose Creek Candidate RNA should be established. The target type of POC-Douglas-fir-

western hemlock forest is poorly represented on Forest Service Lands in California. However, it is an important type and RNA's established elsewhere in Oregon to preserve this type (e.g. SAF 231) are presently in grave danger of losing all mature POC to root rot (Franklin et al. 1972). It appears unlikely that other drainages with any greater integrity including this forest type can be found in the Klamath Province.

In reality, the threat from erosion and fungus spread is manageable, particularly in the southwestern unit if the boundaries are altered as proposed in the following section. Erosion is not a significant issue in the two side drainages because enough intact forest remains in them and a large enough buffer between the cuts and the stream bottoms exists so no apparent increase in stream downcutting has ensued. Revegetation of the cuts has been rapid and all cut slopes within the side drainages appear to be stabilized. This is not the case, however, with the East Fork of Goose Creek itself. Large clear-cuts have been made opposite and upstream from both units. These cuts descend to within only 20-30 m from the creek in most cases and the effect of increased sedimentation and runoff is apparent in the several recent bank slides and cutting into old raised stream terraces along the creek between the two units. This is unfortunate because much of the prime western hemlock subtype occurs on these terraces. Ideally it would be advisable to connect the two units via the narrow forested strip bordering the banks of the East Fork. However, this strip may in some cases be so narrow and so prone to erosion that it may not be useful to do so.

Protection from root rot invasion should be easier to enforce on the southwest unit because only a small portion of it is roaded. The northeast unit, on the other hand, has roads on all slopes within the drainage, including the relatively heavily-traveled G-0 road and road 14N01.

Fortunately the northeast unit has poorer representation of POC than the southwest unit, while the northeast unit has more western hemlock. I would strongly recommend that all unpaved access routes to the drainages housing the two units be gated and no vehicular travel within them allowed during the wet season.

In addressing the question of unnatural disturbance on a proposed RNA, the issue that sticks out for me is that no better site probably exists for this target in the region. In addition, the target element itself is undisturbed, only the surrounded *Pseudotsuga*-hardwood forests are impacted. The impact on those forests in the southwest unit is relatively slight, involving only one relatively small clear-cut in the northwest corner of Section 6 and a small area of selectively logged west-facing forest in the south-central portion of Section 31 and adjacent northcentral Section 6. In the northeast unit, clear-cuts border almost the entire area. However, once within the proposed boundaries no damage is apparent.

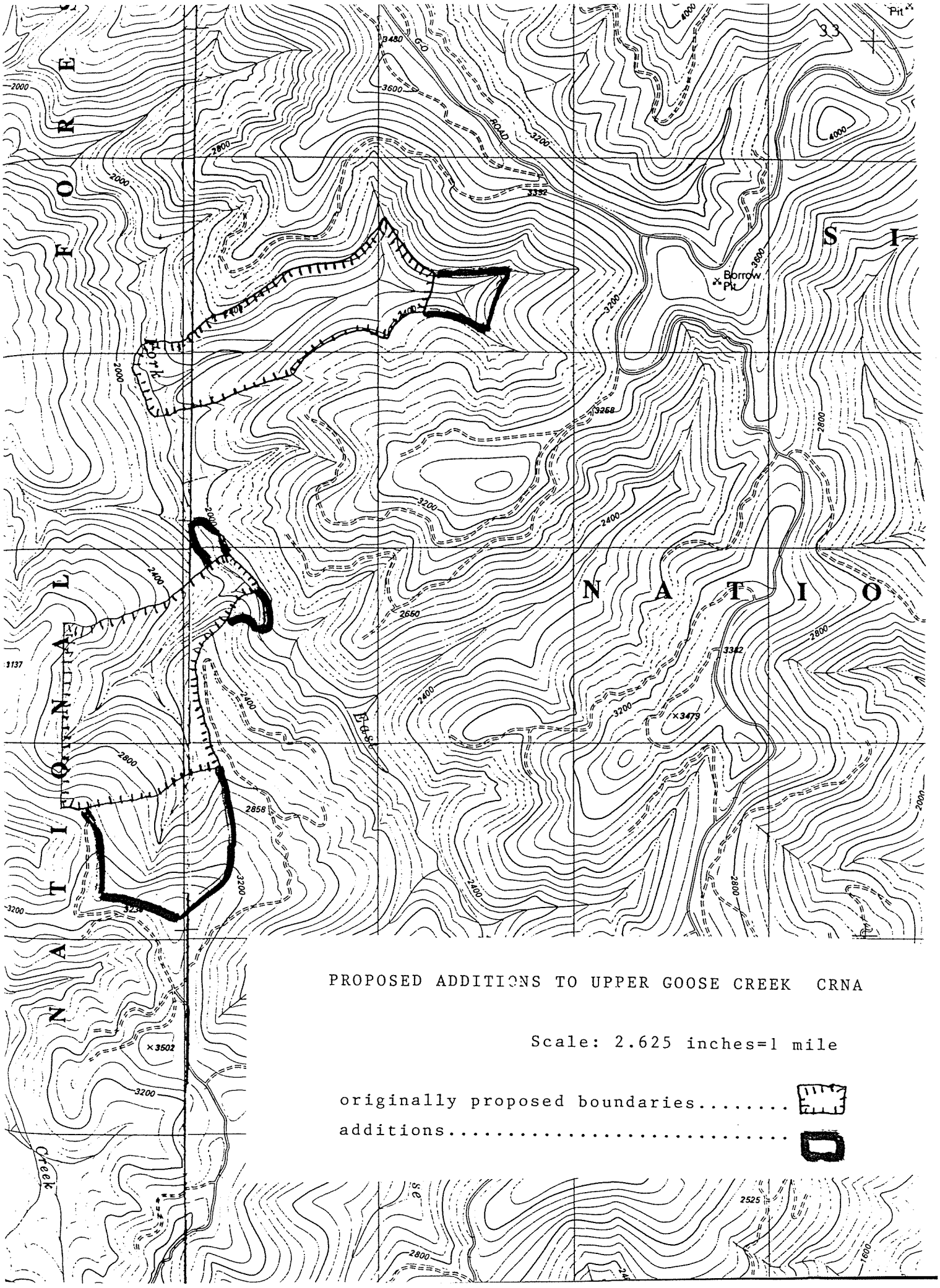
BOUNDARIES

The boundaries drawn up in the RNA proposal should be revised to adequately include the largest portion of the target possible and to insure the natural integrity of each drainage as best as possible. Thus, I have proposed the following extensions to the original boundaries; 1) all of the upper drainage of the southwest unit in the western half of section 6; 2) small lobes on the northeastern end of the southwest unit along the East Fork; and 3) an as yet undetermined distance up-stream from the proposed eastern boundary of the northeast unit to include all POC and western hemlock in the drainage (this probably corresponds to about the 2400 ft

contour along the stream). The proposed additions along with the original boundaries are shown on the map on the following page.

Justifications for the preceding extensions are numbered in corresponding fashion: 1) the upper drainage does contain scattered POC along the creek somewhat above the proposed boundary, more importantly the inclusion of the upper drainage will insure much greater protection of the southwest unit from root rot and from additional impacts of possible logging; 2) the lobes along the East Fork of Goose Creek will include important high density stands of the POC-hemlock subtype; and 3) the northeast unit contains mixtures of both hemlock and POC beyond its originally proposed eastern boundary, it is scientifically important to preserve and study the entire range of the two species to understand their local ecology.

I did not walk the entire length of the East Fork between the two units. However, if this stretch is found to contain good stands of western hemlock on relatively stable terraces and slopes, then I recommend that it should be included within the RNA.


PROPOSED ADDITIONS TO UPPER GOOSE CREEK CRNA
Scale: 2.625 inches=1 mile
originally proposed boundaries.....
additions.....
NATIONAL FOREST
Borrow Pit
Fork
Creek

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APPENDIX: VASCULAR PLANT LIST

The following list of 96 taxa includes only those species identified during my field work from July 25-28, 1986. Abbreviations following the names refer to habitat types in which they occur as defined in the following legend. Taxonomy generally follows Munz, A California Flora and Supplement, U. C. Press 1968.

POC.....POC-Douglas-fir-Western Hemlock
NDF.....North-facing Douglas-fir forest
SDF.....South-to-west-facing Douglas-fir
SF.....Successional forest (logged or burned)
RW.....Riparian woodland

Trees:

Arbutus menziesii; SDF,SF
Acer circinatum; POC, RW
Acer macrophyllum; POC, NDF, SDF, RW
Alnus oregona; RW, POC
Chamaecyparis lawsoniana; POC
Chrysolepis chrysophylla; NDF, SF
Cornus nuttallii; POC, RW
Lithocarpus densiflora; POC, NDF, SDF, SF
Pinus attenuata; SF
Pinus lambertiana; SDF, NDF
Pseudotsuga menziesii; POC, NDF, SDF, SF
Quercus chrysolepis; SDF, SF

Salix sp.; RW

Sequoia sempervirens; SF (a few on or adjacent to western boundary of southwest unit)

Taxus brevifolia; POC

Tsuga heterophylla; POC

Shrubs:

Arctostaphylos cinerea; SF, SDF

Arctostaphylos nevadensis; SF

Berberis nervosa; POC, NDF, SD

Ceanothus velutinus var. *laevicaulis*; SF

Corylus cornuta var. *californica*; POC, NDF

Euonymus occidentalis; RW

Gaultheria shallon; POC, NDF, SDF, SF

Holodiscus discolor var. *delnorticus*; POC, NDF

Rhamnus purshiana; RW

Rhododendron macrophyllum; POC, NDF, SDF, SF

Ribes bracteosum; RW

Rosa gymnocarpa; SF, SDF

Rubus ursinus; POC, NDF, SDF, SF

Rubus parviflorus; POC, RW

Rubus leucodermis; SF, RW

Rubus spectabilis; RW

Toxicodendron diversiloba; SDF, SF

Vaccinium ovatum; POC, NDF, SDF, SF

Vaccinium parvifolium; POC, NDF

Herbs:

Adenocaulon bicolor; POC

Achlys triphylla ; POC, NDF

Actaea rubra subsp. *arguta*; POC, RW

Adiantum pedatum var. *aleuticum;* RW

Agrostis exarata; SF

Agrostis longiligula; RW

Aira caryophyllea; SF

Aralia californica; RW

Anemone deltoidea; POC

Athyrium filix-femina; RW

Aquilegia formosa var. *truncata*; RW

Blechnum spicant; POC, RW

Boschniakia strobilacea; SDF

Boykinia elata; POC, RW

Bromus laevipes; POC, RW

Campanula prenanthoides; SF, SDF

Calamagrostis foliosus; (?) RW

Carex ormantha; RW

Chimaphila menziesii; NDF, POC

Chimaphila umbellata; POC

Clintonia uniflora; POC, NDF

Collomia heterophylla; SF, SDF

Coptis lacinata; POC, NDF

Disporum hookeri; POC, NDF

Deschampsia elongata; SF

Erechtites arguta; SF

Equisetum telmateia var. *braunii*; RW

Festuca octoflora; SF

Galium triflorum; POC, RW

Gayophytum sp. SF

Goodyera oblongifolia; POC, NDF

Hieracium albiflorum; NDF, POC, SDF

Hierochloe occidentalis: POC, RW

Iris sp. ; SDF

Lathyrus sp.; SDF

Linnaea borealis; POC

Lotus americanus; SF

Montia cordifolia; POC, RW

Madia madioides; RW

Mitella ovalis; RW, POC

Oxalis oregana; POC

Pyrola picta forma *aphylla*; POC

Phacelia bolanderi; RW

Pteridium aquilinum; SDF, NDF, SF

Sedum spathulatum; SDF, SF

Sedum laxum subsp. *heckneri*; SF

Smilacina racemosa var. *amplexicaulis*; POC, NDF

Streptopus amplexifolius var. *denticulatus*; POC, RW

Petasites palmatus; RW

Polystichum munitum; POC, NDF

Polystichum munitum var. *imbricans*; SDF SF

Selaginella sp; SF

Tiarella unifoliata; POC, RW

Trientalis latifolia; NDF, POC

Tellima grandiflora; POC, RW

Trillium ovatum; POC, NDF

Vancouveria hexandra; POC, NDF

Viola sempervirens; POC, NDF

Whipplea modesta; POC, NDF, SDF, SF

Woodwardia fimbriata; RW

Xerophyllum tenax; NDF, SDF, SF

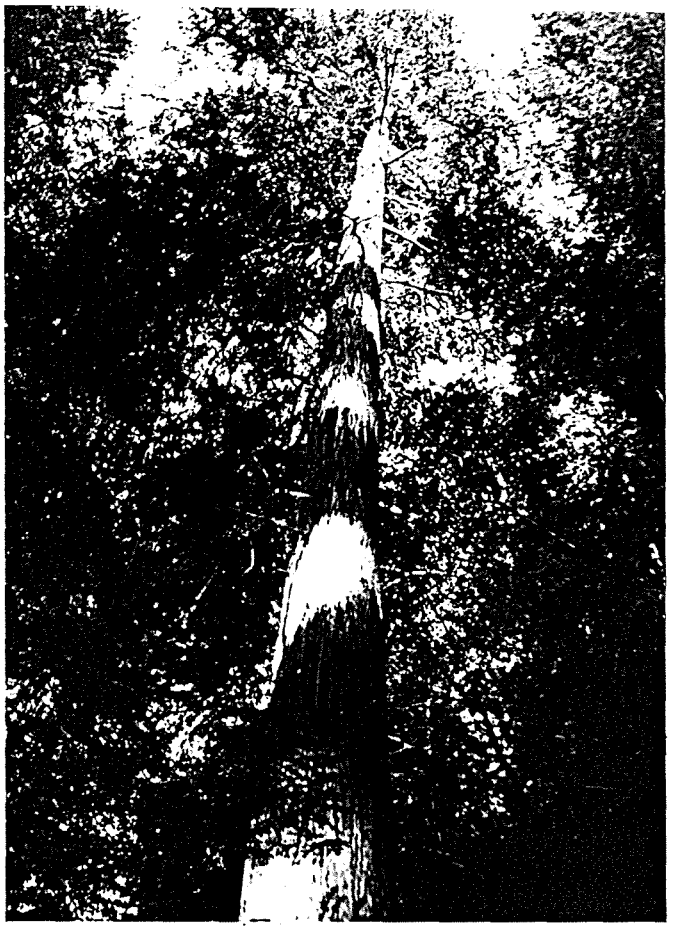


Figure 1. One of the tall POC along the lower part of the stream in the southwest unit. This tree was estimated at 220 ft. tall and had a dbh of 54 inches.

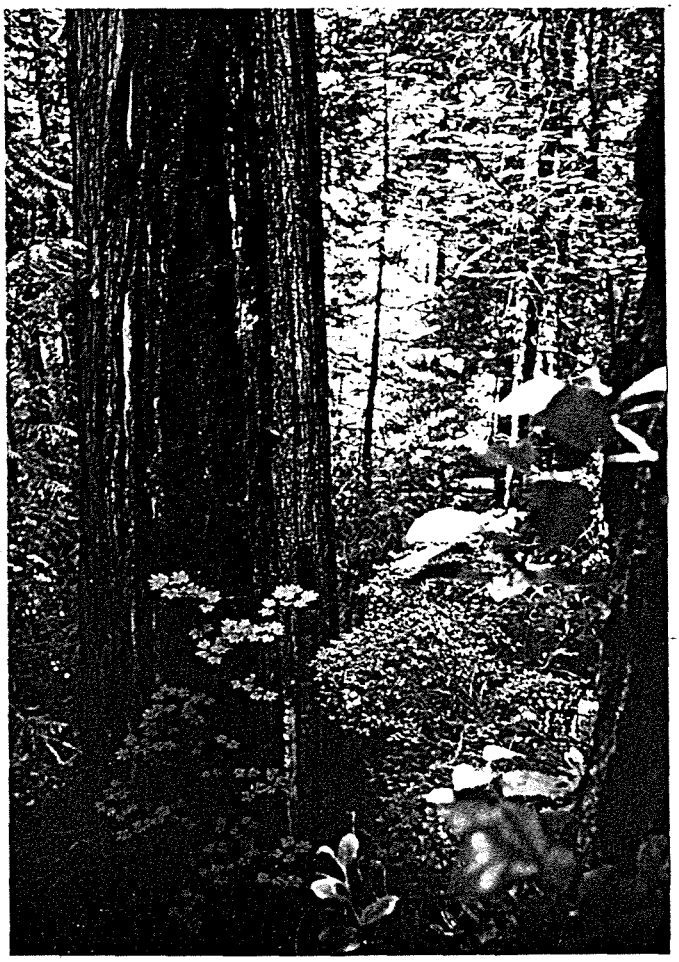


Figure 2. Large cat-face scar on 5 ft. dbh POC in southwest unit. Note typical understory including *Acer circinatum* and *Vaccinium parvifolium*.

Figure 3. POC seedling on mossy log in southwest unit. Note also *Blechnum spicant* and *Tiarella unifoliata*, typical species of such moist, mossy situations in the POC-Douglas-fir forest.

Figure4. Seedlings and saplings of western hemlock on mossy log, a typical germination site for the species.

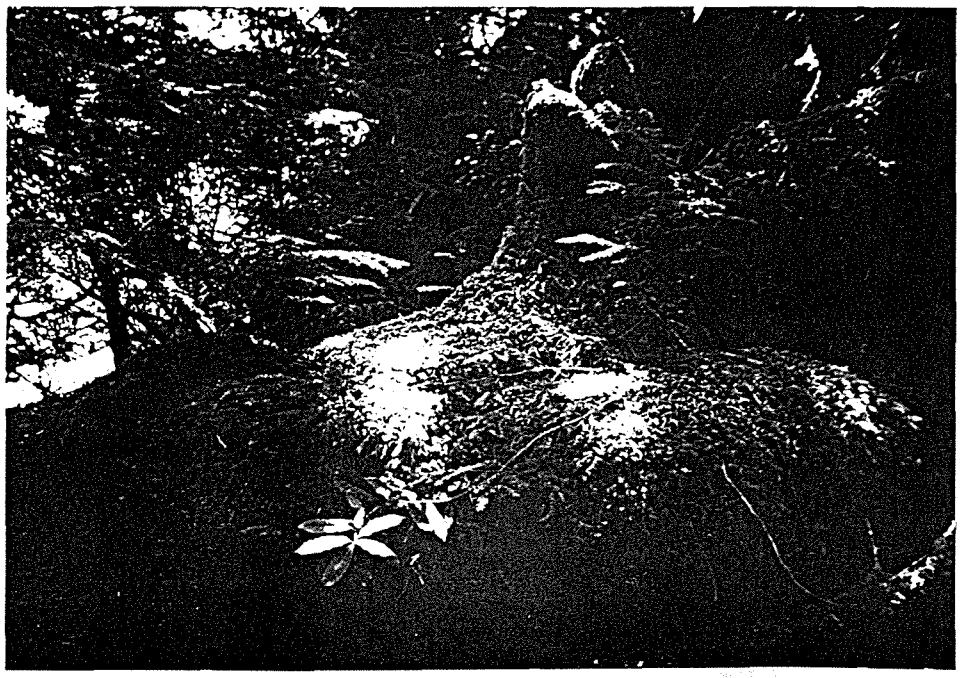
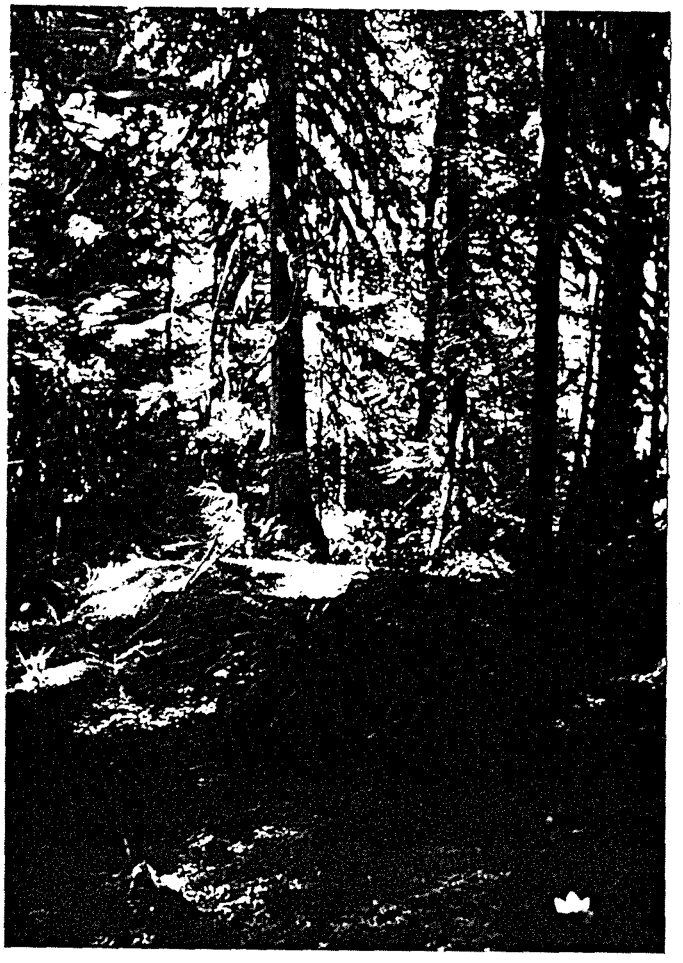


Figure 5. Understory of western hemlock subtype of POC-Douglas-fir-western hemlock forest in the southwest unit. Note relatively sparse understory of scattered shrubs with areas of open duff.

Figure 6. *Coptis lacinata*, a common and important member of the herbaceous understory of the shady portions of the POC-Douglas-fir-western hemlock forest.

by western hemlock with carpet of *Oxalis oregana* and scattered *Polystichum munitum* along the East Fork of Goose Creek.



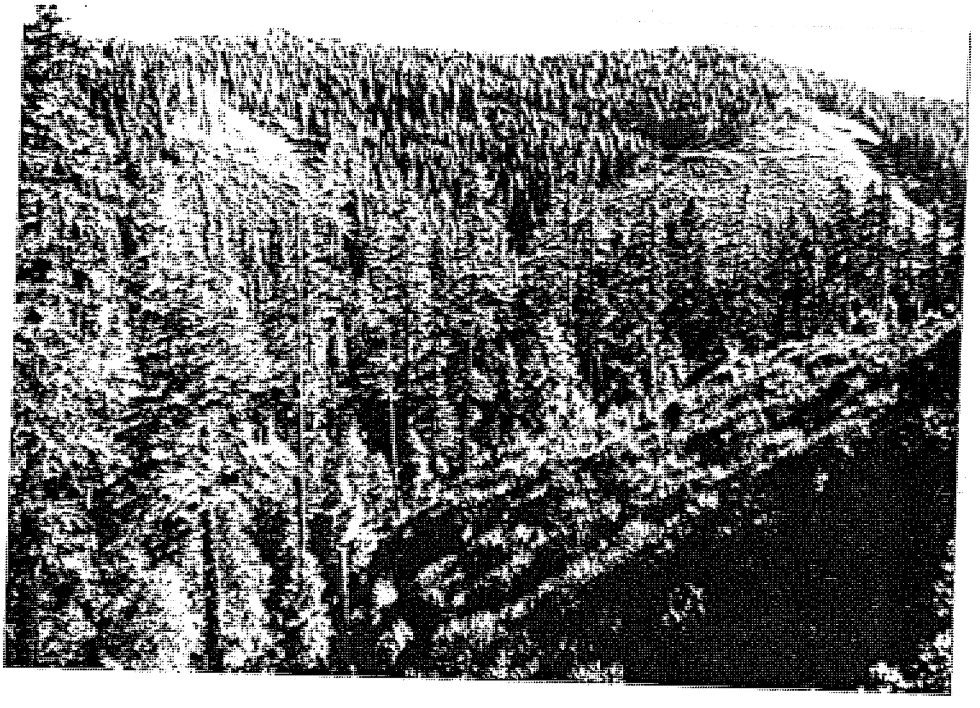


Figure 8. View along the southern border of the northeast unit. Note the typical cover of *Pseudotsuga*-dominated forest on all slope aspects which have not been clear-cut. Also note the relatively well-developed hardwood understory within the forest dominated by *Chrysolepis chrysophylla*. Adjacent clear-cut is dominated by *Ceanothus velutinus* var. *laevicaulis*.

Figure 9. View looking southeast across the southwest unit within the successional forest dominated by 25-35 ft. Lithocarpus and Arbutus. This forest is at the edge of the study area and was clear cut ca 40-45 years ago.

Figure 10. View looking east from a point ca. 2 miles south of the southwest unit toward Doctor Rock in the Siskiyou Mountains. Note the aspect difference between north and south slopes with hardwoods on south and Douglas-fir on north. Also note some indication of hardwood dominance on north slopes and *Pseudotsuga* dominance on south slopes, indicating the variability of dominance based on fire history and the extent of canopy damage.

...typical open canopy of Douglas-fir over low, shrubby understory of resprouting and sapling hardwoods on an north-facing slope in the southwest unit.

Figure 12. Well-developed understory on north-facing slope in northeast unit. Sub-canopy dominated by 1-2 ft. dbh *Chrysolepis* with shrubby understory dominated by *Rhododendron macrophyllum* and *Vaccinium ovatum*

Figure 13. Understory of *Pseudotsuga*-dominated forest on north slope at ca 3300 ft. in southwest unit. Note dense cover of *Rhodendron macrophyllum* and open Douglas-fir canopy with occasional small trees of *Chrysolepis* in sub-canopy.

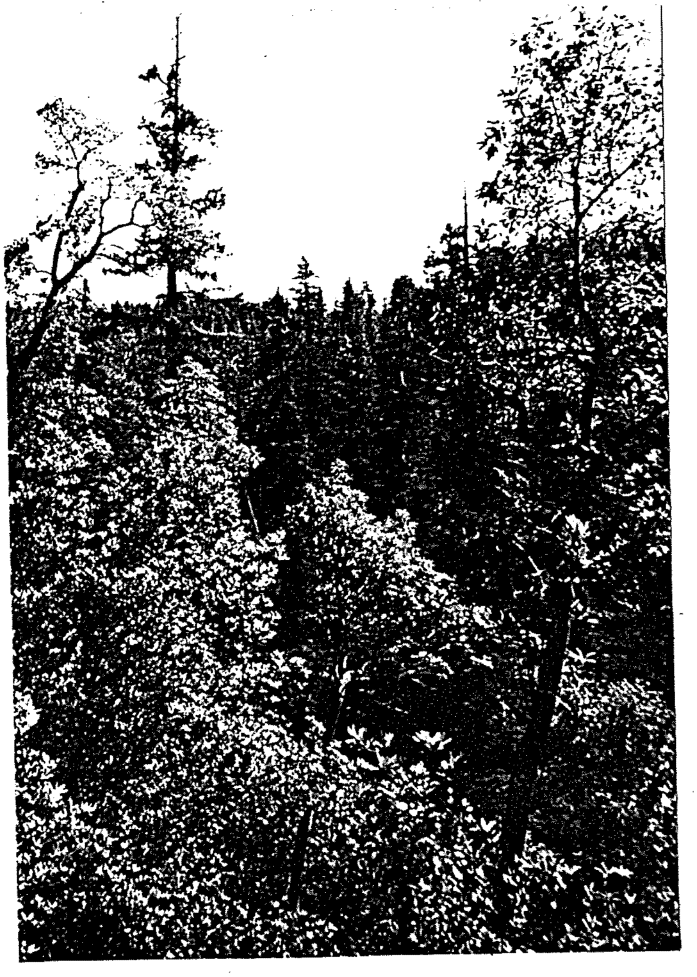


Figure 14. Large survivor trees of *Arbutus* over younger resprouts of *Lithocarpus* in opening on west-facing slope in southwest unit.

Figure 15. View looking northeast over north-facing slope at western edge of the southwestern unit. Note understory of sclerophylls dominated by *Chrysolepis* and *Lithocarpus* with few relict trees of old *Pseudotsuga* canopy. This forest the result of both logging and fire.

Figure 16. Typical pool and small waterfall along riparian zone in northeast unit. Note *Adiantum pedatum* var. *aleuticum* along small cliff at left.

Figure 17. Typical riparian zone along the East Fork of Goose Creek at northeast corner of southwest unit. *Alnus oregona* dominant, surrounded by POC-Douglas-fir-western hemlock forest.